THE IMPLEMENTATION OF ANALYTICAL HIERARCHY PROCESS (AHP) IN RISK ASSESSMENT AND ITS LIMITATION IN CONSTRUCTION INDUSTRY IN PAHANG

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ABSTRAK

Sifat dinamik dan kompleks projek pembinaan menyebabkan wujudnya ketidakpastian dan kecenderungan yang tinggi untuk kemalangan dan insiden berlaku. Sehubungan dengan itu, pengurusan risiko yang lebih menyeluruh perlu dilaksanakan sejak daripada awal permulaan projek lagi. Penilaian risiko dapat membantu untuk mengenal pasti kemungkinan punca risiko dan meramal kesan negative terhadap projek. Penilaian dapat dilakukan melalui pelbagai teknik termasuklah Monte Carlo Simulation, Sensitivity Analysis, Critical Path Method, Fault Tree Analysis dan lain-lain lagi. DIsebabkan sifat industri pembinaan, tempoh masa yang diperlukan untuk membuat keputusan dalam penyelesaian masalah risiko adalah panjang. Untuk mengatasi keadaan sebegitu, Analytical Hierarchy Process (AHP) boleh diaplikasikan. Kajian ini bertujuan untuk (1) mengenal pasti tahap sebenar pelaksanaan Analytical Hierarchy Process (AHP) dalam penilaian risiko dan (2) batasan apabila melaksanakan AHP dan tidak melaksanakan AHP dalam penilaian risiko dalam industri pembinaan. AHP adalah satu kaedah Multiple Criteria Decision Making (MCDM) yang digambarkan dalam struktur hierarki dan perbandingan berpasangan dilakukan untuk mendapatkan nilai setiap alternatif dan keputusan akan dibuat dengan mengambil nilai tertinggi. Metodologi kajian yang digunakan dalam kajian ini adalah analisi kuantitatif (analisis purata) dan koleksi data melalui soal selidik tertutup. Objektif penyelidikan dijawab melalui analisis data yang lengkap dengan bantuan Statistical Software for Social Science (SPSS). Dapatan dari analysis, pelaksanaan AHP di dalam penilaian risiko di industri pembinaan Pahang adalah rendah berdasarkan analisis yang telah disiapkan. Penilaian individu tidak boleh digunakan sebagai satu pertimbangan adalah keterbatasan utama seperti yang dinyatakan dalam analisis. Sementara itu, kewujudan pelbagai faktor dalam projek juga adalah merupakan had utama mengapa AHP tidak dilaksanakan dalam industri. Bagi tujuan kajian masa hadapan, kajian ini boleh diteruskan lagi bagi menyumbang kepada pencarian cara untuk mempertingkatkan tahap pelaksanaan AHP dalam industri yang berkenaan. Untuk meningkatkan kadar pelaksanaan teknik AHP dalam industry, pendedahan intensif perlu dibekalkan kepada pihak yang berkenaan.

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AHP	Analytical Hierarchy Process
PMBOK	Project Management Body of Knowledge
CIDB	Construction Industry Development Board
PMI	Project Management Institute
ISO	International Standard Organization

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This research is aimed to study on the level of implementation of Analytical Hierarchy Process (AHP) in risk assessment and its limitation in construction area. This chapter mainly described and elaborates on the general idea of this study along with the background of study, problem statements, objectives of the study, scope of study, significance of study, limitation of the study, and lastly the process of research. The objective was identified and the research questions will cover the related issues in this study. There is some restriction which represented by the scope of study and the significance of the study is represented the importance to conduct this study. A figure of the research process is presented in this chapter.

1.1 BACKGROUND OF STUDY

The Construction industry has developed and its rapid positive growth. After an economic depression period, it became one of the major economic contributors to the country as it is the fourth largest employer of the Malaysia workforce (Haminah, 2008). It has contributed to the economy in the path towards developing country for Vision 2020. Although construction industry only contributed less than five (5) percent of the Gross Domestic Product (GDP), but this industry has the strength of connection to other economic sector (CIDB, 2006). As mentioned by Behm (2008), construction industry with the strength of dynamic and rapid changing able to bring huge impact to the country. Vrihjoef and Tong (2004) have the same idea with Behm, they stated that the change of the project composition makes construction industry to more complex and vibrant. Risk and uncertainty are existing because the working environment.

Consequently, failure in managing risk in the construction project will cause losses in term of financial, resources, and the most important one is reputation of the organization. Thus, risk in a construction project has become a concern by the manager. The reason is time delay and cost overruns if any, risk incident happened (Adnan et al., 2008). As the client of the project i very sensitive to the cost aspect, so the manager or contractors need to confirm the project is without any unwanted incident to avoid the extra cost to be incurred.

The mode to deal with the risk in the construction industry still depends heavily on contracts, the industry has a bad reputation because involved in many disputes and claims (Baloi et al., 2003; Adnan et al., 2008). Project life cycle processes of a construction project which consist of planning, development, monitoring and closing are complicated (Nadeem et al., 2010). Due to the complexity, the industry indirectly caused the existence of higher uncertainty and risk. Therefore, a comprehensive risk management should be executed by the project manager or safety officer and required active involvement from all the related parties in the construction industry.

Risk management is one of the knowledge areas among the ten knowledge areas stated in the Project Management Body of Knowledge (PMBOK). There is an essential to develop a proper yet effective risk management plan for the industry as the construction projects often fail to achieve their time, budget, and quality goals (Prasanta, 2002). This is most probably because of the failure of the contractor to analyze and assess all risk factors.

Risk assessment is a process of prioritizing risk for the analysis of assessing and combining the probability of event occurrence and associated impacts. The risk magnitude can be assessed by considering two parameters: risk likelihood and risk severity. Factor index is introduced to structure and evaluate these factors and integrate them into the decision making process of risk assessment.

Risk assessment has become a helpful process in assist the project manager to identify the potential risk level. There are some challenges when conducting risk assessments (EPA, 2009). These challenges refer to the duration needed in complex

problem decision making and data shortage make the assessment invalid. To ease the complex decision making, AHP can be adopted. It is one of the decision making technique for multi-criteria decision making (MCDM). This AHP is a method that can be used to analyze and assess project risks, then prioritize the risk importance, so that the significant risks that need extra concern by the parties involved can be determined and lastly, decision making to resolve the issues.

The AHP is a famous decision making technique in prioritizing alternatives among multi-criteria and multi-attributes. It able analyze and assess project risk, then prioritize during the progress of a construction project and to overcome the limitations of the approaches that currently used by contractors. The AHP able to provide a flexible, easy understanding way to provide the decision-maker in formulating the problem in a logical and rational manner (hierarchical structure).

1.2 PROBLEM STATEMENT

The construction industry is exposed to higher risk due to its complex and dynamic project nature (Behm, 2008). The complexity of work activities is associated with its potential risk. Risk can be defined as an uncertain event or condition that, if it occurs, has a positive and negative impact on the achievement towards the project objective (PMI, 2014). Instead of the negative impact, risk also can be described as a combination of the probability of an event occurrence and its consequences if occurred. According to PMBOK (2008), risk management is a systematic process contains 4 main phases which are risk identification, risk analysis, risk response, and risk monitoring and reviewing. A risk assessment will be discussed in this study.

Risk assessment is one of the processes in the risk management process (Mohammad & Jamal, 1991). In this stage, the identified potential risk from the previous process which is identification is further decomposed. The probability of occurrence of the potential risk event and its associated impact on the project is estimated by using probability impact matrices. The risk with the highest rank will affect the project the most.

Implementation of effective risk management can support all the related parties in the project to determine the risk level of the potential unwanted event and next contributed to a better decision making process for the project. There are many risk assessment techniques can be adopted as listed by Zeng et al. (2007). The technique includes Monte Carlo Simulation, Sensitivity Analysis, Critical Path Method, Fault Tree Analysis, Scenario Planning and AHP. Nevertheless, these quantitative techniques required a high quality data are the prerequisite. In this study, AHP is selected to be used in risk assessment.

Although the AHP is widely used in decision making, but there is some limitation to apply. These limitations became a barrier to the decision maker to not use AHP when making any decision. In short, for a complicated project decision making, AHP is the most suitable to be applied in order to get the best option of solution. The objectives of this study are to identify the level of implementation of AHP in risk assessment and to study the limitation when applying AHP in risk assessment in the construction industry.

1.3 RESEARCH OBJECTIVES

i) To identify the level of implementation of AHP in risk assessment in construction industry.

ii) To study the limitation of applying AHP and when not applying in risk assessment in construction industry.

1.4 RESEARCH QUESTIONS

This study is conducted to answer the following questions:

i) How frequent of implementation of Analytical Hierarchy Process (AHP) in risk assessment in construction industry?

ii) What is the limitation when implementing AHP and not implementing AHP in risk assessment in construction industry?

1.5 SCOPE OF STUDY

The aimed of the study is to study the implementation of Analytical Hierarchy Process (AHP) in risk assessment and its limitation of implementation. The study will focus in construction industry area in Pahang state. The study will be carried out by using questionnaire survey. Grade 7 construction companies that registered under the Construction Industry Development Board (CIDB) will be selected in this study. The reason Grade 7 construction companies is selected is that the higher grade reflects the size of project and the capability of the companies. To ensure the data obtained is reliable, only Grade 7 construction Company is chosen among other grades of construction companies.

From the chosen companies, all the relevant information will be gathered specifically about the implementation of AHP in risk assessment and its limitations. All the information will be analyzed and finalized to get the results of the study either it is significant or not.

1.6 SIGNIFICANCE OF STUDY

The significance of this research is to identify the level of implementation of risk assessment. The understanding of risk management and the importance of implementation potentially provide the contractors or developers the right information about the project and the risk associated from the project activities. Through the analysis from the expert judgment obtained from the AHP, an effective decision could be made.

AHP can illustrate how possible changes in priority in upper level have an effort on the priority of criteria in lower level decision making. In addition, AHP has its stability and flexibility regarding changes within and additions to the hierarchy. This method able to rank the criteria of risk, according the impact of risk which leads to a more precise decision concerning to manage the risk incident in the construction industry. According to Omkarprasad & Kumar (2006), the decision maker able to

manage the risk alternatives by using a hierarchy structure and evaluate the score. The positive impact of risk assessment can also provide assistance to involved parties to take necessary action to manage the risk and thus increase the project success probability.

All the information from this study can be used as the guidance of future research about risk assessment, implementation of AHP, strength and limitation of this AHP technique.

1.7 LIMITATION OF STUDY

i. The goodness of the data may be affected due to the time constraint in collecting data within 1 month.
ii. The result of the research is applicable within Malaysia due to the scope restriction which is the data collection only focus within Pahang area.
iii. A little or none of formal documentation on the negotiation case by the construction company which contribute to high difficulties in data access
iv.

1.8 EXPECTED RESULT

This study is expected to identify the level of implementation of Analytical Hierarchy Process (AHP) in risk assessment in the construction industry. Through the questionnaire survey, it is expected the total implementation can be determined. At the same time, the limitation of implementing and not implementing AHP in risk assessment is studied.

1.9 PROCESS OF RESEARCH

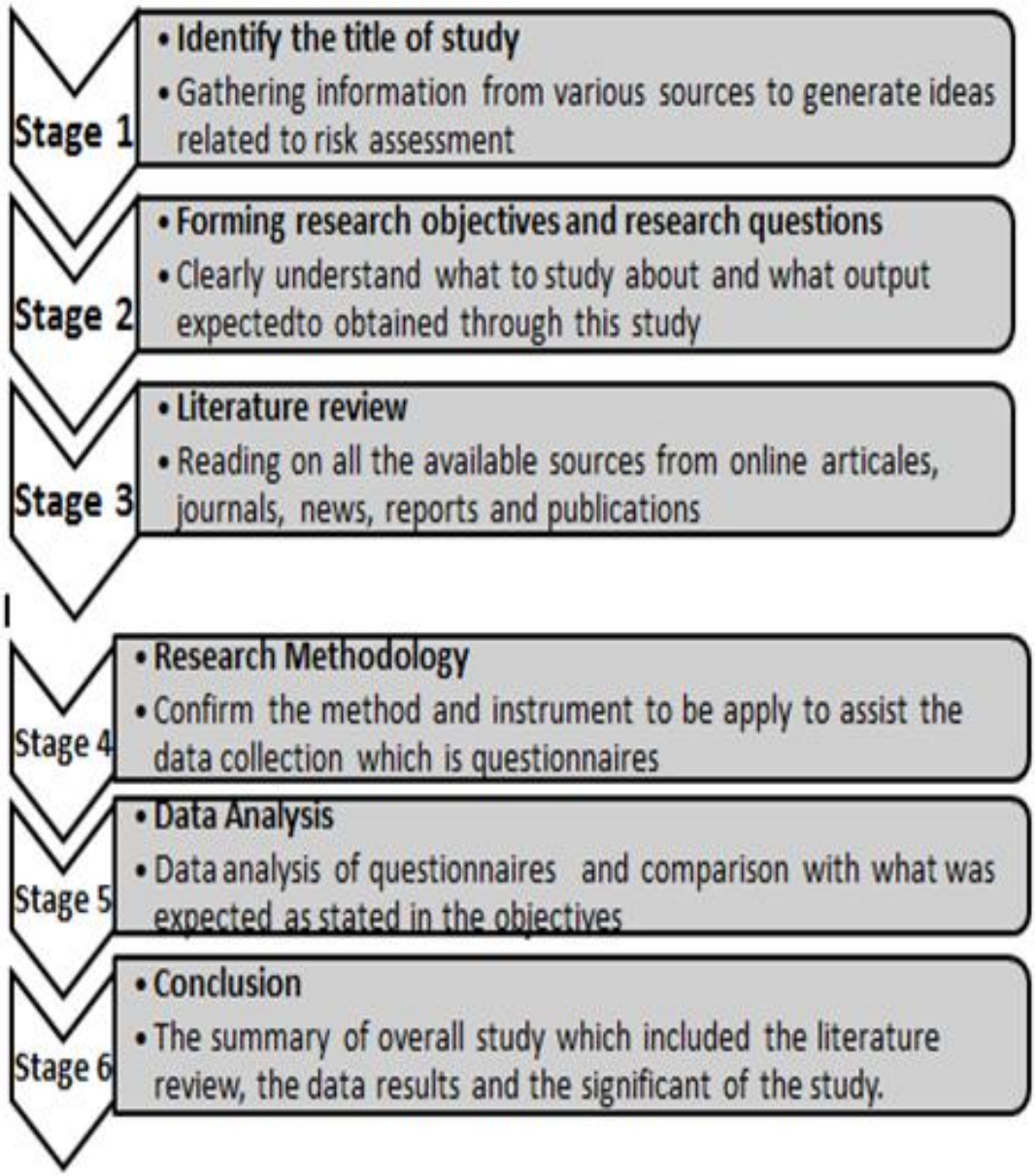

Figure 1.1: Process of Research

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter will discuss about the literature review of the journals, articles, reports, publications, web sources and etc. by the former researchers and scholars. The previous article related to this study is done to support and provide a better understanding about the study. The article has a significant relation to the study title, which is a risk assessment, Analytical Hierarchy Process (AHP) and the limitation of AHP.

2.1 CONSTRUCTION

Currently, the construction industry is an important sector that generates the national economies and development. The working environment in the industry had become more complex due to the existence of high uncertainties in the project phases (Chan et al., 2004). The construction project is vulnerable because of its complex nature. Behm (2008) has the same opinion that construction is a large, dynamic, and complex industry that plays an important role in the economy. Moreover, the construction industry is exposed to more risks due to the higher uncertainty of construction phases compared to other industries (Smith, 2003). Construction projects with long duration and lack of awareness of working condition makes the likelihood of an unwanted incident occurrence increase. Hence, there is a necessary that planning an effective risk management plan by the industry players so that the project risk will be lowered to the minimum.

2.2 PROJECT

Different scholars and researchers have different concepts and perception in defining the projects. The project can be long term and short term. Project Management Institute (PMI, 2014) and the British Standard Institute (BSI, 2002) stated that a project is temporary endeavor which has a defined beginning and ending duration, and contains defined scope and resources so that the project objectives can be achieved. As the project is becoming bigger and on expanding at stake, it is very hard to deal with all the details without a systematic control (Vidal et al., 2011). Hence, project management is the designed as a formalized and structured methodology to guide the practice in project to achieve the goal and objectives.

According to the PMI, 74 percent of projects fail. These failures might come from the project phases which are initiation, planning, executing, controlling and closing. Project management can be defined as the planning, organizing, scheduling, leading, communicating, and controlling of work activities to achieve a predefined outcome, on time and within budget (Cheryl & James, 2005). Triple constraints of a project (time, quality, and cost) are the challenges for the project manager in managing the projects. The project can be completed within budget and time yet meet the requirement is very strait to be achieved.

Besides that, a project also can face failure from the weakness in project divisions (PMI, 2014). There are ten project knowledge areas listed in the PMBOK 5th edition as a guide in practice. In brief, from this ten project knowledge areas shows that a project requires a wide range application of the knowledge and skills and practice it in real working situations so that the manager can manage projects successfully and bring the projects to meet the desired goals and objectives. In this study, concentration is put on project risk management.

2.3 RISK

Risk is hard to be defined as it is very subjective. Professional personnel such as engineers, designers and manufacturer view risk from technological aspect. In other hand, accountant, clients, suppliers and the investors view risk from the financial aspect. This is supported by Jannadi and Almishari (2003) which stated that, risk can be view from several fields. Basically, risk is defined as the possible negative impact to the project. In simple terms, risk is a potential threat that might bring into effect.

According to PMI, project risk is an uncertain event or condition that, if it happened, has a positive or negative impact on the project objectives such as scope, schedule, cost and quality (PMI, 2014). As mentioned by Mark et al. (2004) that risk potentially with raise issues that might project delay of delivery. No construction project activities are free from risk, it cannot be eliminated fully, but it can reduce the impact of risk to the minimum level through an effective management of risk, Usually, risks in a project can be treated in different ways, that is, avoid, transfer, eliminate and accept.

Risk is the mixture of the probability of an event and its consequences (ISO, 2002). In a simply said, the likelihood of an unexpected event to be taking place together with the level of impacts of the occurrence will determine the level of level of risk. Industry especially construction usually exposed to higher risk compared to other sector increase the probability of the workplace accident occurrence. Risk might exist when a decision is made by the manager without any proper analysis conducted. Past research has been done for risk management in construction projects, the finding shows that the identification of many risks may influence the project delivery due to time consuming. Chen et al. (2004) stated that, a project might contain several of risk that can impact on the project. There is a necessary to manage and control the different risk (Barandon, 2004). An organization must commit to addressing risk management throughout the project life cycle.

2.4 PROJECT RISK MANAGEMENT IN CONSTRUCTION INDUSTRY

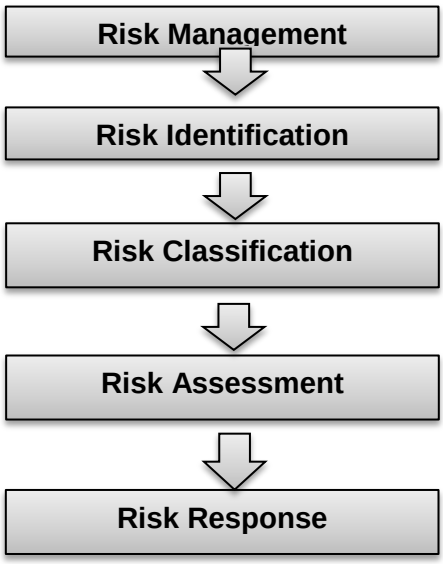

Figure 2.1: Risk Management Process

Nowadays, in concern to the rapid growth of technology and external environment influences, risk management appears as a management tool to cope with risks. In Malaysia, risk management is a fresh management concept that has gotten attention recently (Haminah, 2008; Norazian et al., 2008). The new introduced management required a longer period of time to completely understand and applied practically. Construction sector experienced higher risk exposure due to its diversity of work activities. Risk existed in every human attempt which is stated by Poh and Tah (2006), the probability of occurrence of unwanted accident appeared when construction activities were being carried out.

Risk management related to the monetary aspect of a project. Contingency reserve is an allowance fund from retained earnings to allow for unforeseen losses in business (IAC, 2014). The cost to handling the risk is higher than the cost incurred when preventing it from happening. The probability of occurrence will be reduced through preventing indirectly save the unnecessary cost (Singh & Kalidindi, 2006). To increase the awareness of importance of risk management in the industry, the development of proper risk management processes become a concern by the industry players.

The systematic risk management can assist to handling the risk in a proper manner during the project undergoes. In the pace of the increasing importance of a project, risk management has been recognized as a necessity in most industries today, and a set of techniques has been developed to control the influences brought by potential risks (Baker & Reid, 2005). A systematic process of risk management can be separated into risk classification, risk identification, risk analysis and risk response which illustrated in **Figure 2.1** above (Berkeley et al., 1991). As described by Mills (2001), risk management plays an important role in the decision making process in a construction project. This is because it able to affect the both internal and external of the project. **Figure 2.2** clearly displayed the project risk management overview which abstracted from PMBOK 5th Edition. In this study, risk assessment is the main concern.

In a word, risk management can be used as an indicator to measure the potential changes in value in a different environment between now and coming future.

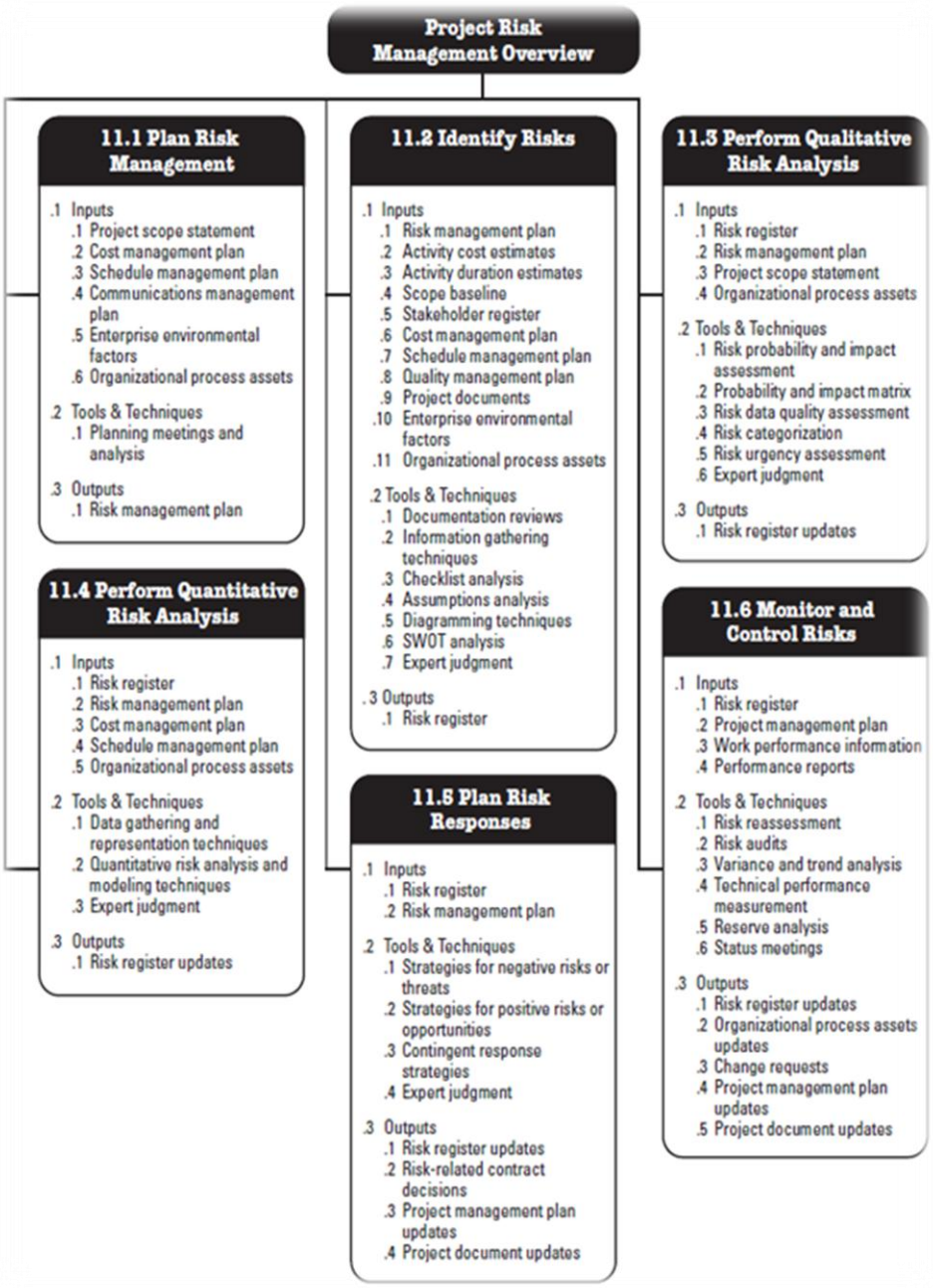

Figure 2.2: Project Risk Management Overview in PMBOK

Source: Project Management Body of Knowledge, 5th Edition

2.4.1 Risk Identification

The risk identification process in a project is important to achieve the objective of the risk management plan. Risk identification attempts to identify the uncertainty existed in an ongoing project (Finance, 2004). The purpose is to identify systematically all the sources of risk within a project and the cause of the risks. Thus, risk identification can be assumed that is the most crucial step in risk management (Thompson & Perry , 1992). Without this step, the risks cannot be analyzed and controlled. Risk identifications cannot be done in a short while, but it should be performed on a regular basis throughout the project (PMI, 1996). Internal and external risk should be addressed in this step. Different guide shows that identification is the most common step in the initiative to manage the risk (Klemetti, 2006). This indicates that identification of potential risk in a project is getting attention by the manager. Identification of the risks initiates the risk management process. According to Chapman (2001), the success of the identification stage is the first step of effective risk management process.

2.4.2 Risk Classification

Risk classification is the second stage in the risk management process, as it helps to structure the various risks that affecting the project (Patrick et al., 2006). There are many approaches can be adapted for classifying risks. Shen et al. (2001) had categorized 58 identified risks associated with a construction joint venture project into six different groups due to the nature of the risks, i.e. financial, legal, management, market, policy and politics and also technical risks. This is supported by Patrick et al. (2006) that, classifying risks, according to their nature and magnitude, by grouping risks associated into two major groupings of primary and secondary risk. Risks can be classified by using hierarchical risk-breakdown structure (HRBS) as delivered by Tah et al. (1993). HRBS allows risks to be separated into those that are related internal risk that established with the external environment. Risk can be further separated into internal and external risk. According to Carr & Tah (2001), the internal risks are the uncertainties congenital by the company involved or the project's nature. Meanwhile,

the external risks are the changeable factors that will have significant impact on the project.

2.4.3 Risk Assessment

The main objective of risk assessment is to estimate the risk by identifying the unwanted event, the likelihood of occurrence and the consequences of such unwanted event (Azari et al., 2011). Risk identification and risk assessment are the main project success factor because it can aid in decisions making process. There are many risk assessment techniques can be adopted listed by Zeng et al. (2007). The technique includes Monte Carlo Simulation, Sensitivity Analysis, Critical Path Method, Fault Tree Analysis, Effect and Cause Diagram is the most earlier quantitative techniques used to assess the risk. There are some arguments to these methods as they only useful with quantitative data according the Zeng et al. (2007). Effort on classifying the risk inherent in the construction project is essential (Mohammad & Jamal, 1991). In the same year, Analytical Hierarchy Process (AHP) was introduced for assessing the risk of a construction project. Zodiac and Hussain (2005) had developed a hierarchical structure aggregate risk model for grouping the risk items. AHP was used for risk assessment for the grouping.

2.4.4 Risk Response

Risk response is a process to modify or response to a risk. It is defined by PMBOK Guide61, risk response is the process of developing options and determining the actions to enhance opportunities and reduce threats to the project objectives. A response is addressed to an identified risk. The response options are based on the assessment of the risk before. The right response to the risk can be decided through the assessment. The probability impact matrix is the basic in determining the degree of the action to be taken in response to the risk. There are four types of action can be taken, that is, avoidance, transferences, mitigation and acceptance (PMI, 2014).

Avoidance: Changes in project scope so that an identified risk is no longer relevant. Not all risk can be eliminated, but some specific risk can often be eliminated.

Transference: Transfer of risk to third parties by contracts or insurances.

Mitigation: Initiative to reduce the expected monetary value at risk event by the probability of occurrence and the impact of risk.

Acceptance: Accept the risk and resolve the negative effect when it happened.

2.5 DECISION MAKING METHODS & TECHNIQUES

Decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker (Harris, 1980). The large number of choices and multiple conflicting goals, make the decision process more complex. There are many reasons why decision making is in the trend becoming more difficult, included more intangible elements, rapidly changing conditions and higher uncertainty. There are many tools and techniques can be used in decision making, in this study, some examples of the techniques are listed. This included cost-benefit analysis, multi-criteria decision analysis and fault tree analysis.

Decision making is very subjective due to different peoples with different thinking. Decision making is needed if there are alternatives for a certain problem that required considerations. Decision made must take in all considerations so that to choose the one that best fits with the goals, objectives, desires and values. This is said by Alexander (2012) that decision making requires the use of intelligence, wisdom and creativity to strive the way to survive in the effort to achieve the target.